UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

September 21, 2006

MEMORANDUM TO: ACRS Members

FROM: Eric A. Thornsbury, ACRS Senior Staff Engineer

SUBJECT: CERTIFICATION OF THE MINUTES OF THE MEETING OF THE ACRS SUBCOMMITTEES ON HUMAN FACTORS AND RELIABILITY & PROBABILISTIC RISK ASSESSMENT, JUNE 28, 2006 - ROCKVILLE, MARYLAND

The subcommittee chairmen have certified the minutes of the subject meeting, issued July 11, 2006, as the official record of the proceedings of that meeting. A copy of the certified minutes is attached.

Attachment: As stated

electronic cc: J. Larkins
S. Duraiswamy
M. Snodderly

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

MEMORANDUM TO: Eric A. Thornsbury, ACRS Senior Staff Engineer

FROM: Mario V. Bonaca, Chairman
Human Factors Subcommittee

SUBJECT: CERTIFICATION OF THE MINUTES OF THE MEETING OF THE ACRS SUBCOMMITTEES ON HUMAN FACTORS AND RELIABILITY & PROBABILISTIC RISK ASSESSMENT, JUNE 28, 2006 - ROCKVILLE, MARYLAND

I do hereby certify that, to the best of my knowledge and belief, the minutes of the subject meeting on June 28, 2006, are an accurate record of the proceedings for that meeting.

Mario V. Bonaca 9/20/06

Mario V. Bonaca
Subcommittee Chairman

Date

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

MEMORANDUM TO: Eric A. Thornsbury, ACRS Senior Staff Engineer

FROM: George E. Apostolakis, Chairman
Reliability & Probabilistic Risk Assessment Subcommittee

SUBJECT: CERTIFICATION OF THE MINUTES OF THE MEETING OF THE ACRS SUBCOMMITTEES ON HUMAN FACTORS AND RELIABILITY & PROBABILISTIC RISK ASSESSMENT, JUNE 28, 2006 - ROCKVILLE, MARYLAND

I do hereby certify that, to the best of my knowledge and belief, the minutes of the subject meeting on June 28, 2006, are an accurate record of the proceedings for that meeting.

9/7/06

George E. Apostolakis
Subcommittee Chairman

Date

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

July 11, 2006

MEMORANDUM TO: Mario V. Bonaca, Chairman
Human Factors Subcommittee

George E. Apostolakis, Chairman
Reliability & Probabilistic Risk Assessment Subcommittee

FROM: Eric A. Thornsbury, ACRS Senior Staff Engineer

SUBJECT: WORKING COPY OF THE MINUTES OF THE MEETING OF THE ACRS SUBCOMMITTEES ON HUMAN FACTORS AND RELIABILITY & PROBABILISTIC RISK ASSESSMENT, JUNE 28, 2006 - ROCKVILLE, MARYLAND

A working copy of the minutes for the subject meeting is attached for your review. Please review and comment on them. If you are satisfied with these minutes, please sign, date, and return the attached certification letter.

Attachment: Minutes (DRAFT)

cc: Human Factors Subcommittee Members
Reliability & Probabilistic Risk Assessment Subcommittee Members
J. Larkins
S. Duraiswamy
M. Snodderly
C. Santos

Issued: 7/11/2006
Certified: 9/20/2006

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MEETING OF THE ACRS SUBCOMMITTEES ON
HUMAN FACTORS AND
RELIABILITY & PROBABILISTIC RISK ASSESSMENT
MEETING MINUTES - JUNE 28, 2006
ROCKVILLE, MARYLAND

INTRODUCTION

The ACRS Subcommittees on Human Factors and Reliability & Probabilistic Risk Assessment held a meeting on June 28, 2006, in Room T-2B3, 11545 Rockville Pike, Rockville, MD. The purpose of this meeting was to review issues related to the agency's current research on Human Reliability Analysis, including the ATHEANA User's Guide, the application of ATHEANA to pressurized thermal shock, public comments on the HRA Methods Evaluation NUREG, and the treatment by HRAs of the time to complete tasks. Eric Thornsbury was the Designated Federal Official for this meeting. The Subcommittee received no requests for time to make oral statements from the public. The Subcommittee received a written statement submitted by Mr. Zouhair Elawar, a PRA Engineer at Palo Verde Nuclear Generating Station, concerning treatment of time in HRA. The Subcommittee Chairman convened the meeting at 8:30 a.m. on June 28, 2006 and adjourned at 2:15 p.m..

ATTENDEES

ACRS Members

G. Apostolakis, Subcommittee Chairman
M. Bonaca, Subcommittee Chairman
W. Shack, Member
T. Kress, Member
E. Thornsbury, Designated Federal Official

Principal NRC Speakers

E. Lois, RES
A. Kolaczkowski, SAIC
S. Cooper, RES
J. Forester, SNL

Other Principal Speakers

J. Julius, Scientech/EPRI

Other members of the public attended this meeting. A complete list of attendees is in the ACRS Office File and is available upon request. The presentation slides and handouts used during the meeting are attached to the office copy of these minutes.

OPENING REMARKS BY CHAIRMAN APOSTOLAKIS

Dr. George Apostolakis, Chairman of the ACRS Subcommittee on Reliability & Probabilistic Risk Assessment, convened the meeting at 8:30 a.m. Dr. Apostolakis stated that the purpose of this meeting was to review issues related to the agency's current research on Human Reliability Analysis, including the ATHEANA User's Guide, the application of ATHEANA to pressurized thermal shock, public comments on the HRA Methods Evaluation NUREG, and the treatment by HRAs of the time to complete tasks. He said the Subcommittee would gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee. The rules for participation in the meeting were announced as part of the notice of the meeting published in the Federal Register on May 25, 2006. Dr. Apostolakis acknowledged that the Committee had received no requests for time to make oral statements, but did receive a written statement submitted by Mr. Zouhair Elawar, a PRA Engineer at Palo Verde Nuclear Generating Station, concerning treatment of time in HRA.

DISCUSSION OF AGENDA ITEMS

Application of ATHEANA to Pressurized Thermal Shock

Mr. John Monninger, Deputy Director for Probabilistic Risk and Applications in the Office of Nuclear Reactor Research, opened the meeting by reviewing the recent meetings the ACRS has had on the topic of human reliability analysis (HRA). He stated the staff's appreciation of the reviews, then introduced the topics for the day and the corresponding speakers. Mr. Monninger then passed the presentation to the first primary speaker, Mr. Alan Kolaczkowski.

Mr. Kolaczkowski first described the purpose of the presentation on an "Example Application of ATHEANA." ATHEANA is A Technique for Human Event ANAlysis, the staff's second-generation HRA method. The primary reason for the presentation was a request by Members at previous meetings. The goal was to illustrate both the qualitative and quantitative aspects of the use of ATHEANA to provide a better understanding and background for the other topics discussed at the meeting. Mr. Kolaczkowski briefly discussed the historical development of ATHEANA, and noted that the use of ATHEANA for the pressurized thermal shock (PTS) probabilistic risk assessment (PRA) was the first full application of ATHENA to include the quantification method for human error probabilities.

Mr. Kolaczkowski introduced the example application used for the discussion, the Palisades PTS HRA. He specifically highlighted the makeup of the analysis team, which provided a wide range of perspectives to the analysis and improved the understanding of the contexts surrounding the scenarios. He also highlighted the number of types of information sources used for the analysis which provided a high level of detail. Mr. Kolaczkowski noted that they performed the HRA in parallel with the PRA and other portions of the PTS analysis.

Mr. Kolaczkowski continued the example by stepping through the ATHEANA analysis process. The first three steps included the definition of the issues, the scope of the analysis, and the base case scenario. Because the staff built this PTS research on previous work, the use of a single base case scenario was impractical. Mr. Kolaczkowski illustrated the ATHEANA concept of the base case versus deviation scenarios to demonstrate the process used during the

Palisades PTS HRA to break up a single human failure event to explicitly account for multiple contexts.

Mr. Kolaczkowski provided more extensive discussion on step four of the ATHEANA process, where the analyst defines the human failure events and/or unsafe acts. The analysis team first identified the general classes of human failure events for PTS based on how operators can influence the key safety functions. Mr. Kolaczkowski explained that this identification process included both errors of omission and errors of omission. He also provided an example of how the general classes of human failure events initially identified eventually evolve into more specific events. Mr. Kolaczkowski noted that the team did not model the failures at the more detailed unsafe act level during the PTS analysis and completed the discussion of step four by pointing out that they performed only a limited review for errors of commission since they had already identified more likely, procedure-driven actions that could lead to the undesired state.

Mr. Kolaczkowski continued by describing step six, searching for factors that could lead to potential vulnerabilities. This step begins the search for error forcing contexts and includes evaluating procedures, crew characteristics, operator expectations, and plant response time lines. The findings from this step provided clues to the analysts regarding the types of deviation scenarios to examine, such as defeat of the main feedwater runback, delay in execution of emergency procedures, and additions to the crew's workload.

Mr. Kolaczkowski then described the results of steps six, seven, and eight, which determined that some deviation scenarios were not worth pursuing, either due to a very unlikely context or a high likelihood of recovery. Other deviation scenarios appeared to be particularly troublesome. He then described the final ATHEANA step, quantification, where the important elements of the scenario context were explicitly incorporated in the PRA model. Mr. Kolaczkowski also described a variation on ATHEANA's quantification approach implemented during the Palisades assessment that attempted to capture the aleatory factors through the construction of a consensus probability distribution.

<u>Comments and Observations From the Subcommittee Members</u>

- Dr. Apostolakis asked if other HRA methods do a similar breakup of human failure events to account for different contexts. Mr. Kolaczkowski replied that most HRAs are likely to use a more general context. Dr. Apostolakis stated that an experienced HRA analyst should do this step. Mr. Kolaczkowski agreed, but noted that ATHEANA makes it a formal step in the HRA. Dr. Cooper further elaborated on the need for the formal process to account for different contexts.

- Dr. Shack asked when a PRA analyst can live with a simpler structure that does not include as many deviations. Mr. Kolaczkowski replied that it depends upon the effects on the system, and that ATHEANA forces the question of whether the PRA model needs more structure.

- Dr. Apostolakis asked about the precision of the times for the HRA, for example, on the failure to isolate main feedwater in 30 minutes. Mr. Kolaczkowski acknowledged that some uncertainty exists in the timing, and in those areas where it was critical, the team interacted with the thermal-hydraulics team to refine the estimates.

- Dr. Apostolakis asked whether the analysts performed screening during the HRA analysis. Mr. Kolaczkowski replied that as the assessment progressed from plant-to-plant, the analysts applied their experience to screen out events. Dr. Apostolakis asked if they used a systematic screening process. Mr. Kolaczkowski answered that no formal guidance exists for screening in ATHEANA. He agreed that more thought might be beneficial in this regard. Continued discussion on ideas for screening involved Dr. Bonaca, Dr. Kress, Mr. Julius, Dr. Nathan Siu (RES), Mr. Bob Fuld (Westinghouse), and Dr. Cooper.

ATHEANA User's Guide

Dr. Susan Cooper provided the presentation on the ATHEANA User's Guide. The underlying purpose of the User's Guide is to promote technology transfer to provide a better understanding of ATHEANA to potential users, including the ATHEANA process, how and when to apply it, and its strengths and limitations. She noted that the User's Guide provides updated guidance based on lessons learned from actual applications and includes complete guidance on the quantification approach, which the current ATHEANA NUREG does not contain. More specifically, the guide provides better guidance on treating base case scenarios, evaluating the role of performance shaping factors on scenarios, and performing quantification for a range of potential contexts for a human failure event.

Dr. Cooper continued with an overview of the structure of the User's Guide. She described how it illustrates differences between ATHEANA and other HRA methods and provides more straightforward descriptions of the ATHEANA process. She also briefly discussed the details of the quantification formula as described in the guide.

Dr. Cooper then discussed comments received during the peer review and internal review of the draft User's Guide and some of the staff's initial thoughts on the comments. The comments regarding screening, the use of point estimates for the human error probabilities, where ATHEANA can add value, and whether the guide should stand alone attracted the most attention from the Members.

Dr. Cooper completed the presentation by addressing the bottom line from the review process. The review provided a number of positive and constructive comments, particularly regarding the qualitative insights that ATHEANA can provide and the need for improvements to the quantification process. The comments also suggest that the report needs to more clearly communicate ATHEANA's benefits in order to encourage more regular use. The staff plans to revise the guide using the review comments and informal feedback from the Members, use it in a pilot application, and provide a revised guide in the summer of 2007.

Comments and Observations From the Subcommittee Members

- Dr. Apostolakis suggested that the staff should examine a Brookhaven report on screening measures for human actions that might prove helpful.

- Dr. Apostolakis requested an opportunity to see the guide again before the staff finalizes it. Dr. Lois replied affirmatively and added that the staff plans to pilot the guide before they finalize it.

- Dr. Kress suggested the staff ignore the comments received regarding the need to focus on the point estimate for the human error probabilities.

- Dr. Apostolakis asked if the staff has any plans to address the infamous Ispra HRA exercise discussed during previous meetings. Dr. Lois answered that the staff is planning a benchmark exercise next year to address the issues and plans to include international participation.

- Dr. Apostolakis suggested that a joint project with EPRI may also be helpful, similar to that done in the fire research program. Dr. Lois noted that the staff is working to extend the memorandum of understanding that governed the joint fire research to enable similar cooperation in HRA.

- Dr. Apostolakis suggested that the guide remain stand-alone as much as possible. Dr. Shack noted that too much detail would defeat the point of the User's Guide.

- Dr. Shack suggested that the key concern is the question of when to use ATHEANA, which a more common PRA does not currently have. Dr. Cooper addressed this on a later slide as another suggestion from the review process that the staff plans to address.

Public Comments on HRA Methods Evaluation NUREG

Dr. Erasmia Lois provided a presentation for this portion of the meeting. She reminded the Members that the ACRS had previously reviewed and discussed the NUREG prior to its issuance for public comments. The staff has since received public comments and plans to address them and submit the final version for publication in September 2006. She reviewed the ten HRA methods evaluated in the document and noted that the staff collected comments during a public meeting and from the EPRI HRA User's Group, Progress Energy, and various other individuals.

Dr. Lois then summarized the comments received. Some comments expressed concern about the overall negative impression of the document, though some comments agreed with some of the stronger criticisms discussed in the document. She also discussed comments regarding the inaccuracy of all human error probabilities, making distinctions between HRA methods and HRA tools, the positive aspects of the EPRI HRA Calculator (particularly in the latest revision), the use of time reliability correlations, bias toward ATHEANA, the use of simulation modeling techniques, and the use of actual experience for pre-initiator actions instead of methods such as ASEP or THERP. Dr. Lois concluded by discussing the staff's plan to address the comments.

Comments and Observations From the Subcommittee Members

- Dr. Shack pointed out that while all models are approximations (as stated in a comment on the NUREG), some models may not be very good approximations.

- Dr. Apostolakis agreed with the comment to consider other terminology to clarify the distinction between methods and tools.

Focusing HRA on Time to Complete Tasks

The final session of the subcommittee meeting was an informal, round-table discussion regarding focusing on the time to complete tasks in HRA. The primary participants in the discussion included Dr. Apostolakis, Dr. Kress, Mr. Julius, Dr. Gareth Parry (NRR), Dr. Siu, Dr. Cooper, Dr. Lois, Mr. Fuld, and Mr. Kolaczkowski.

Dr. Apostolakis initiated this topic at the December 2005 subcommittee meeting, and drafted a brief paper on the issue following that meeting. He opened this discussion noting that he became concerned about the issue of time based on the results of several Halden experiments discussed at the previous meeting. In addition, current regulatory activities such as extended power uprates can shorten the amount of time available for operator actions. Dr. Apostolakis then summarized the written comments submitted by Dr. Zouhair Elawar on the same topic. Dr. Apostolakis suggested that an approach similar to that used in reliability physics might be useful where the stress-strength interference defines the probability of failure. He noted that earlier work during the HCR/ORE project produced time curves and that current work at Idaho National Laboratory is constructing event time lines from operating experience.

Mr. Jeff Julius then discussed his thoughts on the concept. He described how the HRA Calculator uses time lines to make decisions whether sufficient time exists for human actions based on time data from thermal hydraulic analysis, simulator data, operator interviews, and other sources. He discussed a way to represent human failure events as a series of detection, diagnosis, decision, and action steps. But because it is difficult to distinguish cognitive actions in a simulator, the Calculator collapses the cognitive steps into one.

Dr. Parry noted that the ORE experiments demonstrated success. Dr. Forester added that the ORE project always had correct diagnosis as part of the human actions. Dr. Apostolakis asked what the experiments actually recorded. Dr. Parry replied that they recorded the time to start the response action and the time to finish the response.

Mr. Julius showed some of the empirical timing results from HCR/ORE and several participants discussed the meaning and use of the normalization constant, particularly Dr. Apostolakis and Dr. Parry. Dr. Parry also noted that the system's time window for action is typically far out on the time axis. Mr. Julius then showed how the real response time curve compares to the lognormal extrapolation.

Dr. Siu commented that HRA needs to know more than just the lack of a response, which requires more information than only the time available. Dr. Kress added that other branches in the analysis would be necessary to account for the possibility of the operators being on the wrong path. Dr. Apostolakis suggested that instead of working directly on the probability, ATHEANA should modify the time curves. Dr. Cooper responded that the technical basis underlying ATHEANA does not support such an approach, as the "big events" that they have seen in real accidents occur because the operators are on the wrong path, and time for action is not a dominant factor. Dr. Lois added that the staff built ATHEANA to address severe accidents.

Dr. Apostolakis noted that it appears that the Office of Research and EPRI are developing their HRA approaches along different lines. He suggested that perhaps a collaborative effort may be able to blend the approaches to address some of the concerns, as some of the concepts described during the discussion on the PTS application seem similar.

Mr. Julius returned to his discussion and pointed out that many events are not time-critical. For those that are, the Calculator uses a cause-based decision tree method (CBDTM). He pointed out similarities with ATHEANA in the failure mechanisms used in CBDTM, which represent failures in the interfaces between the operator and the information or the procedure.

Dr. Apostolakis again pointed out that the RES and EPRI work are not incompatible with each other, just that ATHEANA performs the reliability calculation in the minds of the experts. Dr. Parry commented that the calibration of the time curves and the collection of data is the problem with the time-based data approach. Dr. Apostolakis suggested that either the expert judgement approach or the data-based approach may be missing the whole picture if used by themselves. Mr. Fuld pointed out some of the common criticisms of relying on expert judgement. Mr. Kolaczkowski clarified that he understood Dr. Apostolakis as suggesting that ATHEANA base the expert judgement on simulator data, for example. Dr. Apostolakis acknowledged that time was just one of the important factors in determining operator response, but suggested that the focus be on producing time curves that subsequently produce the human error probability. Dr. Kress phrased it as a calibration of the experts.

Dr. John Forester then discussed the view of the ATHEANA team regarding treatment of time as the dependent variable (i.e., predicting the time to accomplish actions). They see this as an extension of the time-reliability correlation approach, but with consideration of how the performance shaping factors affect that time. He described potential benefits of such an approach, including that time is easier to observe than probability, it allows incorporation of software simulation tools, and may be particularly relevant to ex-control room actions. Dr. Forester also discussed some of the challenges of such an approach, including the treatment of misdiagnosis events that lead to operators following the wrong path.

Dr. Apostolakis acknowledged that legitimate challenges exist in such an approach. He emphasized that he did not expect an immediate solution, but that work needs to be done to examine the concept. Dr. Siu added that it could be either analytically- or simulation-based. Dr. Apostolakis suggested that research on such an approach could also help achieve a consensus among the various HRA approaches. Dr. Siu acknowledged that it could be a useful addition to the HRA toolbox. Dr. Apostolakis also emphasized that this would be a continuation of the evolution of HRA, and that it does not imply that the past work was incorrect. Dr. Parry suggested that a regulatory need could help encourage action on this task.

SUBCOMMITTEE DECISIONS AND ACTIONS

The discussions on the application of ATHEANA and the public comments on the HRA Methods Evaluation NUREG were a direct response to requests from Committee Members. The staff also desired informal feedback on the ATHEANA User's Guide, which the subcommittee provided during the meeting. The subcommittee Members plan to suggest to the full Committee an initiative to recommend a collaborative research effort on human reliability analysis methods between the staff and industry to address the issue of focusing the analysis on the time for human actions.

BACKGROUND MATERIALS PROVIDED TO THE SUBCOMMITTEE PRIOR TO THIS MEETING

Documents	
I.	Kolaczkowski, A., et al., "Oconee Pressurized Thermal Shock (PTS) Probabilistic Risk Assessment (PRA)," Chapter 7, "Human Reliability Analysis," Letter Report, March 3, 2005.
II.	ATHEANA User's Guide.
III.	None provided. Refer to USNRC, "Evaluation of Human Reliability Analysis Methods Against Good Practices," draft NUREG, 9 November 2005, distributed at previous subcommittee meeting and February 2006 full Committee meeting.
IV.	None provided.

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Note: Additional details of this meeting can be obtained from a transcript of this meeting available for downloading or viewing on the Internet at http://www.nrc.gov/what-we-do/regulatory/advisory/acrs.html or purchase from Neal R. Gross and Co., Inc., (Court Reporters and Transcribers) 1323 Rhode Island Avenue, NW, Washington, DC 20005 (202) 234-4433.

or by e-mail at *pdr@nrc.gov*. In addition, the Penfield Library, located at State University of New York, Oswego, New York, 13126, has agreed to make the final Supplement 24 to the GEIS available for public inspection.

FOR FURTHER INFORMATION, CONTACT: Mr. Samuel Hernandez, Environmental Branch B, Division of License Renewal, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001. Mr. Hernandez may be contacted by telephone at 1–800–368–5642, extension 4049 or via e-mail at *SHQ@nrc.gov*.

Dated at Rockville, Maryland, this 16th day of May, 2006.

For the Nuclear Regulatory Commission.

Michael Masnik,

Acting Branch Chief, Environmental Branch B, Division of License Renewal, Office of Nuclear Reactor Regulation.

[FR Doc. E6–8037 Filed 5–24–06; 8:45 am]

BILLING CODE 7590–01–P

NUCLEAR REGULATORY COMMISSION

Advisory Committee on Nuclear Waste; Notice of Meeting

The Advisory Committee on Nuclear Waste (ACNW) will hold its 171st meeting on June 6–7, 2006, Room T–2B3, 11545 Rockville Pike, Rockville, Maryland.

The schedule for this meeting is as follows:

Tuesday, June 6, 2006

1 p.m.–1:15 p.m.: Opening Statement (Open)—The ACNW Chairman will make opening remarks regarding the conduct of the meeting.

1:15 p.m.–3:15 p.m.: Overview of Commercial Spent Nuclear Fuel Reprocessing (Open)—A former ACNW Committee member will brief the ACNW on theory and technology used in the past to reprocess spent nuclear fuel.

3:30 p.m.–4:30 p.m.: NRC's spent Nuclear Fuel Reprocessing Regulation (Open)—The NRC staff will update the Committee on the implications of a Department of Energy Nuclear fuel Recycling Program to NRC regulations concerning the licensing of spent nuclear fuel recycling facilities.

4:30 p.m.–5:30 p.m.: Overview of the Application of NRC Regulations to Spent Nuclear Fuel Reprocessing (Open)—The NRC staff will brief the Committee on potential changes to the regulatory process that may be needed to accommodate spent nuclear fuel reprocessing.

5:30 p.m.–6 p.m.: Discussion of Proposed White Paper (Open)—The Committee will discuss the planning for scope and content of a potential ACNW White paper on spent nuclear fuel reprocessing.

Wednesday, June 7, 2006

8:30 a.m.–8:45 a.m.: Opening Remarks by the ACNW Chairman (Open)—The ACNW Chairman will make opening remarks regarding the conduct of the meeting.

8:45 a.m.–4 p.m.: Miscellaneous (Open/Closed)—The Committee will discuss matters related to the conduct of ACNW activities and specific issues that were not completed during previous meetings, as time and availability of information permit. Discussions may include future Committee Meetings.

Note: A portion of this meeting may be closed pursuant to 5 U.S.C. 552b (c) (2) and (6) to discuss organizational and personnel matters that relate solely to internal personnel rules and practices of ACNW, and information the release of which would constitute a clearly unwarranted invasion of personal privacy.

Procedures for the conduct of and participation in ACNW meetings were published in the **Federal Register** on October 11, 2005 (70 FR 59081). In accordance with these procedures, oral or written statements may be presented by members of the public. Electronic recordings will be permitted only during those portions of the meeting that are open to the public. Persons desiring to make oral statements should notify Mr. Michael R. Snodderly (Telephone 301–415–6927), between 8:15 a.m. and 5 p.m. ET, as far in advance as practicable so that appropriate arrangements can be made to schedule the necessary time during the meeting for such statements. Use of still, motion picture, and television cameras during this meeting will be limited to selected portions of the meeting as determined by the ACNW Chairman. Information regarding the time to be set aside for taking pictures may be obtained by contacting the ACNW office prior to the meeting. In view of the possibility that the schedule for ACNW meetings may be adjusted by the Chairman as necessary to facilitate the conduct of the meeting, persons planning to attend should notify Mr. Snodderly as to their particular needs.

In accordance with Subsection 10(d) Public Law 92–463, I have determined that it is necessary to close portions of this meeting noted above to discuss organizational and personnel matters that relate solely to internal personnel rules and practices of ACNW, and information the release of which would constitute a clearly unwarranted invasion of personal privacy.

Further information regarding topics to be discussed, whether the meeting has been canceled or rescheduled, the Chairman's ruling on requests for the opportunity to present oral statements and the time allotted, therefore can be obtained by contacting Mr. Snodderly.

ACNW meeting agenda, meeting transcripts, and letter reports are available through the NRC Public Document Room (PDR) at *pdr@nrc.gov*, or by calling the PDR at 1–800–397–4209, or from the Publicly Available Records System component of NRC's document system (ADAMS) which is accessible from the NRC Web site at *http://www.nrc.gov/reading-rm/adams.html* or *http://www.nrc.gov/reading-rm/doc-collections/* (ACRS & ACNW Mtg schedules/agendas).

Video Teleconferencing service is available for observing open sessions of ACNW meetings. Those wishing to use this service for observing ACNW meetings should contact Mr. Theron Brown, ACNW Audiovisual Technician (301–415–8066), between 7:30 a.m. and 3:45 p.m. ET, at least 10 days before the meeting to ensure the availability of this service. Individuals or organizations requesting this service will be responsible for telephone line charges and for providing the equipment and facilities that they use to establish the video teleconferencing link. The availability of video teleconferencing services is not guaranteed.

Dated: May 19, 2006.

Andrew L. Bates,

Advisory Committee Management Officer.

[FR Doc. E6–8035 Filed 5–24–06; 8:45 am]

BILLING CODE 7590–01–P

NUCLEAR REGULATORY COMMISSION

Advisory Committee on Reactor Safeguards; Meeting of the Joint ACRS Subcommittees on Reliability and Probabilistic Risk Assessment and Human Factors; Notice of Meeting

The ACRS Subcommittees on Reliability and Probabilistic Risk Assessment (PRA) and Human Factors will hold a joint meeting on June 28, 2006, Room T–2B3, 11545 Rockville Pike, Rockville, Maryland.

The entire meeting will be open to public attendance.

The agenda for the subject meeting shall be as follows:

Wednesday, June 28, 2006—8:30 a.m. until 3 p.m.

The joint Subcommittees will review three current human reliability assessment issues: the ATHEANA User's Guide, the application of ATHEANA to pressurized thermal shock, and comments received on the HRA Methods Evaluation NUREG. The Subcommittee will hear presentations by and hold discussions with representatives of the NRC staff and industry regarding this matter. The Subcommittees will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee.

Members of the public desiring to provide oral statements and/or written comments should notify the Designated Federal Official, Mr. Eric A. Thornsbury (Telephone: 301–415–8716) five days prior to the meeting, if possible, so that appropriate arrangements can be made. Electronic recordings will be permitted.

Further information regarding this meeting can be obtained by contacting the Designated Federal Official between 7:30 a.m. and 4:15 p.m.(ET). Persons planning to attend this meeting are urged to contact the above named individual at least two working days prior to the meeting to be advised of any potential changes to the agenda.

Dated: May 18, 2006.

Michael R. Snodderly,

Acting Branch Chief, ACRS/ACNW.

[FR Doc. E6–8033 Filed 5–24–06; 8:45 am]

BILLING CODE 7590–01–P

NUCLEAR REGULATORY COMMISSION

Advisory Committee on Reactor Safeguards; Meeting of the ACRS Subcommittee on Digital Instrumentation and Control Systems; Notice of Meeting

The ACRS Subcommittee on Digital Instrumentation and Control Systems will hold a meeting on June 27, 2006, Room T–2B3, 11545 Rockville Pike, Rockville, Maryland.

The entire meeting will be open to public attendance.

The agenda for the subject meeting shall be as follows:

Tuesday, June 27, 2006—8:30 a.m. until the conclusion of business.

The Subcommittee plans to review the ongoing digital system risk program and the development of regulatory guidance on risk informed digital system reviews. The Subcommittee will hear presentations by and hold discussions with representatives of the NRC staff regarding this matter. The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee.

Members of the public desiring to provide oral statements and/or written comments should notify the Designated Federal Official, Mr. Eric A. Thornsbury, (Telephone: 301–415–8716) five days prior to the meeting, if possible, so that appropriate arrangements can be made. Electronic recordings will be permitted.

Further information regarding this meeting can be obtained by contacting the Designated Federal Official between 7:30 a.m. and 4:15 p.m.(ET). Persons planning to attend this meeting are urged to contact the above named individual at least two working days prior to the meeting to be advised of any potential changes to the agenda.

Dated: May 18, 2006.

Michael R. Snodderly,

Acting Branch Chief, ACRS/ACNW.

[FR Doc. E6–8034 Filed 5–24–06; 8:45 am]

BILLING CODE 7590–01–P

PRESIDIO TRUST

Notice of Public Meeting

AGENCY: The Presidio Trust.

ACTION: Notice of public meeting.

SUMMARY: In accordance with section 103(c)(6) of the Presidio Trust Act, 16 U.S.C. 460bb note, Title I of Public Law 104–333, 110 Stat. 4097, as amended, and in accordance with the Presidio Trust's bylaws, notice is hereby given that a public meeting of the Presidio Trust Board of Directors will be held commencing 6:30 p.m. on Thursday, June 15, 2006, at the Golden Gate Club, 135 Fisher Loop, Presidio of San Francisco, California. The Presidio Trust was created by Congress in 1996 to manage approximately eighty percent of the former U.S. Army base known as the Presidio, in San Francisco, California.

The purposes of this meeting are to approve minutes from the last Board meeting, to adopt a revised budget for Fiscal Year 2006, to provide an Executive Director's Report, to present the final Supplemental Environmental Impact Statement in connection with the rehabilitation of the Public Health Service Hospital, and to receive public comment in accordance with the Trust's Public Outreach Policy.

Accommodation: Individuals requiring special accommodation at this meeting, such as needing a sign language interpreter, should contact Mollie Matull at (415) 561–5300 prior to May 31, 2006.

FOR FURTHER INFORMATION CONTACT: Karen Cook, General Counsel, the Presidio Trust, 34 Graham Street, P.O. Box 29052, San Francisco, California 94129–0052, Telephone: (415) 561–5300.

Dated: May 22, 2006.

Karen A. Cook,

General Counsel.

[FR Doc. E6–8114 Filed 5–24–06; 8:45 am]

BILLING CODE 4310–4R–P

RAILROAD RETIREMENT BOARD

Agency Forms Submitted for OMB Review

Summary: In accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35), the Railroad Retirement Board (RRB) has submitted the following proposal(s) for the collection of information to the Office of Management and Budget for review and approval.

Summary of Proposal(s)

(1) *Collection title:* Employee Representatives' Status and Compensation Reports.

(2) *Form(s) submitted:* DC–2a, DC–2.

(3) *OMB Number:* 3220–0014.

(4) *Expiration date of current OMB clearance:* 7/31/2006.

(5) *Type of request:* Extension of a currently approved collection.

(6) *Respondents:* Business or other for-profit.

(7) *Estimated annual number of respondents:* 65.

(8) *Total annual responses:* 65.

(9) *Total annual reporting hours:* 33.

(10) *Collection description:* Benefits are provided under the Railroad Retirement Act (RRA) for individuals who are employee representatives as defined in section 1 of the RRA. The collection obtains information regarding the status of such individuals and their compensation.

Additional Information or Comments: Copies of the forms and supporting documents can be obtained from Charles Mierzwa, the agency clearance officer (312–751–3363) or *Charles.Mierzwa@rrb.gov.*

Comments regarding the information collection should be addressed to Ronald J. Hodapp, Railroad Retirement Board, 844 North Rush Street, Chicago, Illinois, 60611–2092 or *Ronald.Hodapp@rrb.gov* and to the OMB Desk Officer for the RRB, at the Office of Management and Budget,

Advisory Committee on Reactor Safeguards
Human Factors and Reliability & Probabilistic Risk Assessment Subcommittees Meeting
Rockville, MD
28 June 2006

- Proposed Agenda -
Rev. 06/22/06

Cognizant Staff Engineer: Eric Thornsbury (301-415-8716, eat2@nrc.gov)

	Topic	Presenter(s)	Time
	June 28		
	Opening Remarks and Objectives	G. Apostolakis, ACRS M. Bonaca, ACRS	8:30 - 8:40 am
I	Application of ATHEANA to Pressurized Thermal Shock	A. Kolaczkowski, SAIC	8:40 - ~~10:15~~ 10:30 am
	Break		10:~~15~~30 - 10:~~30~~50 am
II	ATHEANA User's Guide	S. Cooper, RES	10:30 - 11:45 am
	Lunch		11:45 am - 12:15 pm
III	Public comments on HRA Methods Evaluation NUREG	E. Lois, RES	12:15 - 12:45 pm
IV	Focusing HRA on Time to Complete Tasks	Discussion	12:45 - 2:15 pm
	Adjourn		2:15 pm

Notes:
- Presentation time should not exceed 50% of the total time allocated for a specific item.
- Number of copies of presentation materials to be provided to the ACRS - 35.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

JOINT SUBCOMMITTEE MEETING ON

RELIABILITY AND PROBABILISTIC RISK ASSESSMENT/
HUMAN FACTORS

June 28, 2006
Date

PLEASE PRINT

	NAME	AFFILIATION
1	JOHN FORESTER	SANDIA LABS
2	ALAN KOLACZKOWSKI	SCIENCE APPLICATIONS INT'L. CORP
3	JEFF JULIUS	SCIENTECH
4	BOB FULD	WESTINGHOUSE
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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE MEETING ON RELIABILITY AND PROBABILISTIC RISK ASSESSMENT/ HUMAN FACTORS

JUNE 28, 2006

TODAY'S DATE: JUNE 28, 2006

NRC STAFF ATTENDEES PLEASE SIGN BELOW

PLEASE PRINT

	NAME	AFFILIATION
1.	John Forester	NRC/RES/DRASP
2.	Mary Presley	MIT
3.	Susan Cooper	NRC/RES/DRASP
4.	NATHAN SIU	NRC/RES/DRASP
5.	Jose Ibarra	NRC/RES/DRASP
6	GARETH PARRY	NRC/NRR/DRA
7.	Don Marksberry	NRC/RES
8.	Brian Wagner	NRC/RES
9.	Ray Gallucci	DRA/AFPB
10.	JS Hyslop	NRC/RES/DRASP
11.	Charles Moulton	NRR/DRA/AFPB
12.	Gary DeMoss	RES/OEGIB
13.	Sunil Weerakkody	NRC/NRR
14.	Mike Tschiltz	NRC/NRR/DRA
15.	Kendra Hill	NRC/RES/DRASP
16.		
17.		
18.		
19.		

Example Application of ATHEANA

Pressurized Thermal Shock (PTS) Analyses

Erasmia Lois (USNRC)
Alan Kolaczkowski (SAIC)
John Forester (SNL)
Susan Cooper (USNRC)

Presentation to the Advisory Committee on Reactor Safeguards, PRA and Human Factors Subcommittees

Rockville, MD June 28, 2006

Presented By
Alan Kolaczkowski

1

Purpose of Presentation

- Respond to a request by the ACRS to see such an example
- Illustrate the use of ATHEANA (qualitative and quantitative aspects)
- Provide an illustration and background to better understand the ATHEANA User's Guide being developed (topic of separate presentation)

2

Historical Perspective

- Technical Basis and Implementation Guidelines for *A* *T*echnique for *H*uman *E*vent *ANA*lysis, NUREG-1624, Rev. 1 published May 2000
  - Human error probability (HEP) quantification technique (as used for PTS) was not yet incorporated
- ATHEANA used for PTS analyses (2001-2005)
  - Used for 3 plant-specific PTS analyses at varying levels of implementation (Oconee, Beaver Valley, Palisades)
  - HEP quantification technique first tried out most fully for the PTS HRA work
- ATHEANA User's Guide in progress (2006) to simplify the guidance and make it easier to use
  - Considers lessons learned from PTS work

3

Palisades PTS HRA – General
(indicative of Oconee and Beaver Valley PTS HRAs)

- HRA Participants (NRC contractors & Palisades staff)
  - PRA/HRA experienced persons
  - Operator trainers
  - Operations staff including EOP writer / caretaker
  - Engineering (e.g., thermal-hydraulic specialists) staff

  Key point: Multiple perspectives – this enriched our knowledge of scenario contexts (as recommended in ATHEANA)
- Information Sources
  - 1980's vintage PTS work and ongoing Oconee and Beaver Valley analyses
  - Palisades emergency operating and off-normal procedures
  - Palisades training materials
  - Palisades system design and operation documents
  - Existing Palisades PRA model (that was subsequently modified)
  - 1st plant visit discussions and observations of simulator runs with actual crews
  - 2nd plant visit (3 days) – performed expert elicitations to estimate human error probabilities (HEPs) for potentially most important human failure events (HFEs)
  - Question/answer sessions throughout the study

  Key point: Considerable detail and first-hand observations (as recommended in ATHEANA)
- PTS HRA performed at a time when it could/did influence the PRA model structure as well as guide the necessary thermal-hydraulic and fracture mechanics analyses

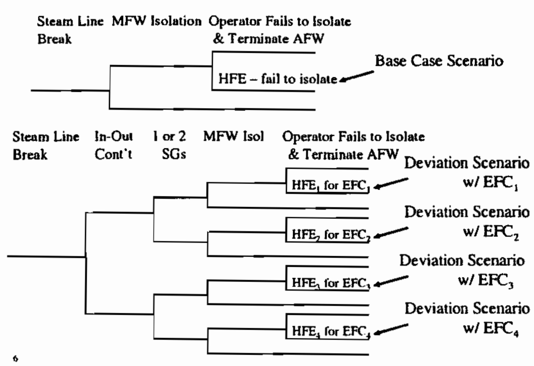
4

First 4 Steps of the ATHEANA Process

- Step 1: Define and interpret issue
  - Need to identify, model and quantify relevant HFEs for PTS challenging sequences
- Step 2: Define scope of analysis
  - Cover internal event initiators (external events handled differently) and subsequent sequences potentially leading to a significant PTS challenge at full power and hot zero power
- Step 3: Describe Base Case Scenario
  - No single base case scenario
    - Transients with complications
    - LOCAs
    - Steam Line Breaks
    - Steam Generator Tube Ruptures
  - Palisades PTS PRA model built on previous work (Oconee, Beaver Valley, existing Palisades PRA with some PTS-related sequences)
  - Previous work already had many variations/complications of the above base cases that would be "deviation scenarios"

5

Illustration of Base Case Scenario vs. Deviation Scenarios



6

First 4 Steps of the ATHEANA Process (cont'd)

Step 4: Define Human Failure Events/Unsafe Acts (HFEs/UAs)

1st identified general classes of HFEs for PTS based on how operators can interact with the functions of interest

Primary Integrity Control	Secondary Pressure Control	Secondary Feed Control	Primary Pressure/Flow Control
Operator fails to isolate an isolable LOCA in a timely manner (e.g., close a block valve to a stuck-open PORV) Operator induces a LOCA (e.g., opens a PORV) that induces or enhances a cooldown	Operator fails to isolate a depressurization condition in a timely manner Operator isolates when not needed (this may create a new depressurization challenge, lose heat sink, etc.) Operator isolates wrong path/SG (depressurization continues) Operator creates an excess steam demand such as opening steam dump or atmospheric dump valves	Operator fails to stop/throttle or properly align feed in a timely manner (overcooling enhanced or continues) Operator feeds wrong (affected) SG (overcooling continues) Operator stops/throttles feed when inappropriate (causes underfeed, may have to go to feed and bleed & possible overcooling)	Operator does not properly control cooling and throttle or terminate injection to control primary coolant system (PCS) pressure Operator trips primary coolant pumps (PCPs) when not suppose to and/or fails to restore them when desirable Operator does not provide sufficient injection or fails to trip PCPs appropriately (modeled as leading to core damage rather than a PTS concern)

7

Step 4: Define Human Failure Events/Unsafe Acts (HFEs/UAs) (continued):

General classes of HFEs were eventually defined as specific HFEs as the modeling evolved

- Example:

  General HFE = Operator fails to stop/throttle or properly align feed in a timely manner

  Specific HFEs modeled in the PRA:
  - **(OP-FGG-1A-30M): Failure to isolate Auxiliary Feedwater (AFW) to a faulted SG by 30 minutes following a small secondary depressurization event**
  - **(OP-FGG-1B-30M): Failure to isolate Auxiliary Feedwater (AFW) to a faulted SG by 30 minutes following a small secondary depressurization event in conjunction with a primary system LOCA**
  - **(OP-FGG-1C-15M): Failure to isolate AFW to a faulted SG by 15 min following a large secondary depressurization event**

8

Step 4: Define Human Failure Events/Unsafe Acts (HFEs/UAs) (continued):

- Did not model human failures at more detailed Unsafe Act (UA) level (as addressed in ATHEANA guidance)
  - "Fail to isolate Auxiliary Feedwater…" illustrative of the level of human failure modeling that was used (as normally done in PRAs)
  - Did not model more detailed specific unsafe acts (UAs) that functionally achieve "fail to isolate Auxiliary Feedwater" such as "failure to close steam paths" modeled separately from "failure to close feed paths"
- There are already procedure-directed actions that could cause a cooldown (act of commission), so performed only a limited review for additional errors of commission (EOCs) for which an error would have to occur (less likely)
  - Examples of commission type events in the model:
    - initiate once-thru-cooling (procedure-directed action)
    - inappropriate trip of primary coolant pumps (an EOC)

9

Step 5: Searching for Factors That Could Lead to Potential Vulnerabilities

Process: (Begins the search for EFCs)

- Evaluate procedures expected to be used in response to various overcooling scenarios
- Develop crew characteristics
- Review operator expectations for various overcooling scenarios
- Understand possible plant response timelines and any inherent difficulties associated with the required response
- Identify operator action tendencies and informal rules

10

Step 5 (cont'd): Searching for Factors That Could Lead to Potential Vulnerabilities

Key Findings for Palisades (Only possible concerns are presented here. Many positive features about Palisades were noted during this step.)

- Auto MFW runback too slow –EOP-1.0 directs manual isolation
  - Greater reliance on MFW control/termination than at some plants
- Entry into other EOPs occurs after EOP-1.0 is completed (offset somewhat by content of EOP 1.0 and possible early steam generator isolation per step 7)
  - Could delay specific actions for cooldown as directed by other EOPs
- Possible reluctance of restarting primary coolant pumps (PCPs) following prolonged pump shutdown as warned in EOP-6.0
  - Restarting of pumps enhances primary coolant mixing and so not restarting could exacerbate PTS in some circumstances
- After EOP-1.0 is completed, one operator takes over control of all boards
  - Could cause workload or similar issues in some circumstances
- Expectations as to cooldown sequences may be limited
  - Training covers some complexities, but not to the level of the anticipated PRA sequences, so less familiarity for some scenarios

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Step 5 (cont'd): Searching for Factors That Could Lead to Potential Vulnerabilities

Key Findings for Palisades (continued)

- A few actions may require "quick" response:
  - Desirable to control secondary problems within 10-30 minutes
  - Isolate primary LOCAs (that are isolable) and trip PCPs quickly
  - Control rapid primary system repressurization within minutes
- Some tendencies/directed responses could be undesirable if not controlled properly or performed erroneously (e.g., increase steam dump if high steam generator pressure exists)
  - Scenarios/context that might induce such responses when not appropriate could be important
- Termination of primary injection is generally late in procedures (offset somewhat by low capability of HPSI <1300 psig)
  - Keeping pressure high longer than desired could exacerbate PTS
- Low power – less familiar and auto protection is less redundant
  - Error likelihood could be greater under hot zero power

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Step 5 (cont'd): Searching for Factors That Could Lead to Potential Vulnerabilities

- Conclusion – Explore, as possible deviation scenarios, scenarios that might:
  - Defeat/delay MWF runback or even cause MFW ramp-up
  - Add delays to the crew getting through EOP-1.0
  - Add to the crew workload and/or go beyond expectations (e.g., multiple functions / equipment failures, key instrument unavailability or failure, support system failures)
  - Require rapid response (e.g., repressurization event, large secondary failure event)
  - Require quick primary injection termination (e.g., rapid repressurization)
  - Combinations of the above
  - Etc.

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Steps 6, 7, and 8: Search for Deviation Scenarios, Consider Complicating Factors, Consider Recovery Potential

Based on the conclusion from Step 5 -

- Explored initiator/sequence progression deviations representing different plant conditions (e.g., various excessive MFW events (to 1 steam generator, to both steam generators), inside-outside containment steam line breaks)
- Explored deviations, and the resulting plant conditions, involving support system faults and support system initiators (e.g., what if event also involves loss of air?)
- Explored deviations, and the resulting plant conditions, involving additional complexities/failures or changes in the timing of events (e.g., coincident primary and secondary "LOCAs", key instrumentation faults/workarounds/latent)
- Considered whether recovery is likely to be easily diagnosed and quickly implemented following any initial operator failure

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Steps 6, 7, and 8 (cont'd): Search for Deviation Scenarios, Consider Complicating Factors, Consider Recovery Potential

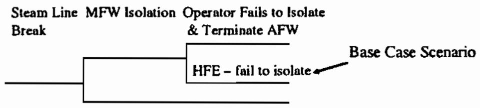
Overall Results of Carrying Out These Steps:

- Some postulated deviations not worth pursuing and so not modeled in the PRA
- Deviation scenarios, and their resulting plant conditions, involving coincident failures of the functions of concern could be particularly troublesome
- Deviation scenarios, and their resulting plant conditions, involving numerous equipment faults and coincident support system faults could be particularly troublesome

- Hence, we checked to ensure that these types of scenarios were either already in the Palisades PTS PRA Model or explicitly incorporated additional deviation scenarios along with relevant HFEs just as conceptually illustrated in Slide 6 (addressed in Step 10, "Incorporate into PRA" of ATHEANA process)

15

Step 9: Quantification (i.e., estimate HEPs)



Typically, the HEP for the HFE would be estimated based on consideration of the "expected" (nominal) context for the sequence

- •plant conditions
- •cues
- •timing…
- •performance shaping factors (PSFs) such as procedure quality, training, HMI…

and then estimate the HEP using prescriptive rules, curves, tables, judgment

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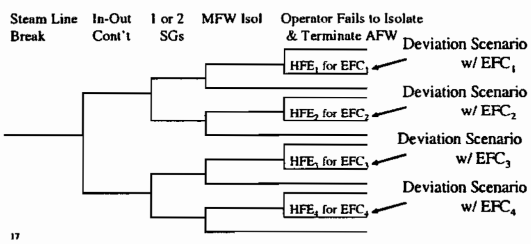
Step 9: Quantification (i.e., estimate HEPs) continued

In the PTS work, for all 3 plant analyses, using ATHEANA, other elements of the scenario context judged to be important to operator performance (hence, further deviations in the context that may result in particularly error-forcing contexts (EFCs)) were explicitly modeled/considered

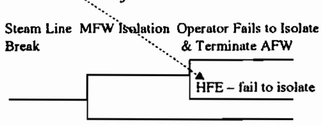


17

Step 9: Quantification (i.e., estimate HEPs) continued

- Had we chosen to not explicitly model the specific EFCs (i.e., keep the PRA structure as is), we would have *explicitly* used the quantification formula in ATHEANA for combining different contexts and corresponding HEPs into one overall HFE and its corresponding single HEP

$$P(HFE|S) = \sum_{ij} P(EFCi|S) \times P(UAj|EFCi,S)$$



18

Quantification: A Facilitator Led, Consensus Expert Judgment Process

- Integrates the knowledge of informed analysts (trainers, operators, plant PRA/HRA staff) to quantify UAs and treat uncertainty (Based on SSHAC report, NUREG/CR-6372)
  - Investigates information and "evidence" "brought to the table" by experts
  - Transforms informed judgment into probability distributions
  - Considers a full range of PSFs, though quantification ultimately dependent on those believed most significant
  - Assesses interactions/dependencies between factors in terms of their influence on performance in the context being examined

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Six Steps to Quantification Process

1: Discuss HFE and possible influences / contexts using a factor "checklist" as an aid

2: Identify "driving" influencing factors and thus most important contexts to consider

3: Compare these contexts to other familiar contexts and each expert independently provide the initial probability distribution for the HEP considering:

– "Likely" to fail	~ 0.5 (5 out of 10 would fail)
– "Infrequently" fails	~ 0.1 (1 out of 10 would fail)
– "Unlikely" to fail	~ 0.01 (1 out of 100 would fail)
– "Extremely unlikely" to fail	~ 0.001 (1 out of 1000 would fail)

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Six Steps to Quantification Process (cont'd)

4: Each expert discuss and justify their HEP

5: Openly discuss opinions and refine the HFE, associated contexts, and/or HEPs (if needed) – each expert independently provides HEP (may be the same as the initial judgment or may be modified)

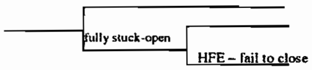
6: Arrive at a consensus HEP for use in the PRA

21

Palisades – A Variation on the Quantification Approach

Let's look at one of the Palisades PTS PRA modeled sequences:

Initiator ADV Recloses Operator Closes ADV Isolation Valve

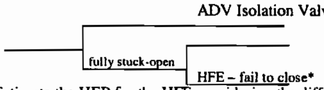


- yet additional aleatory influences affecting operator performance were also considered (but NOT explicitly modeled as shown in slide 17):
  - •Presence (or not) of nuisance alarms
  - •Individual crew differences (e.g., aggressive vs. methodical)
  - •Potential unavailability of key instrument (e.g., because of workarounds, maintenance…)
  - •Etc.

22

Palisades – A Variation on the Quantification Approach (continued)

Initiator ADV Recloses Operator Closes ADV Isolation Valve



*Estimate the HEP for the HFE considering the different additional influences and describe the HEP variability as a probability distribution:

-the 99th percentile is the HEP for the worst coincident (but not too unlikely) set of negative influences representing a very strong EFC

-the 1st percentile is the HEP for the best coincident set of positive influences representing a weak EFC (actually a very positive context)

-other percentiles used to describe a distribution representing the HEPs for different EFCs accounting for the relative likelihood of different EFCs

This is a simplification of explicitly addressing each EFC (i.e., a combination of influences) individually and estimating the HEP for each EFC

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Quantification Example - Failure to isolate a stuck-open atmospheric dump valve (ADV) within 30 minutes (the only significant functional failure in the sequence)

General Context

- Creates a small secondary side depressurization.
- Since the ADV is stuck open, requires that an AO go to the roof and use a "reach-rod" through the wall to perform the isolation.
- While instruction to close any open ADV is indicated in EOP 1.0, the explicit instructions to go onto the roof indicated in EOP 6.0, Step 14.
- Estimated that the crew would get to step in EOP 1.0 in about 5 min. and that it could take 15 min. to diagnose SO ADV, assign AO, and complete the action on the roof.
- Since it was also estimated that it would take about 15 minutes for the crew to reach step 14 in EOP 6.0, crew would probably need to begin the process of getting an AO ready to go before reaching Step 14 in EOP 6.0
- A sheet of instructions are provided to the AO as to how to go up on the roof and isolate the ADV. The action is practiced occasionally.

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Quantification Example - Failure to isolate a stuck-open ADV within 30 minutes (continued)

Additional Aleatory Influences Addressed

- Instrumentation or controls unavailable due to maintenance or failure. In this case, particularly those displaying ADV position.
- Aggressiveness of the crews with respect to anticipating actions, planning ahead, and "taking control" vs. methodically applying procedures.
- Whether crew enters EOP 6.0 or EOP 9.0. Entry into EOP 9.0 could lead them to take a little longer to reach the isolation step.
- Crew "having bad day" (for any number of possible reasons), weaker crew, or a minimum crew present at the start of the event.
- Time of day, weather, and random hardware/equipment problems could have an effect on the crew's ability to complete the action. Limited lighting on the roof and wet, cold, icy, snowy weather could make the task more difficult. Also, if late at night (on night-shift), AOs immediately available to take care of ex-control room actions might be limited.

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Quantification Example - Failure to isolate a stuck-open ADV within 30 minutes (continued)

Basis for the Consensus Distribution

- Likely that crew would diagnose the presence of the stuck-open ADV during Step 7 of EOP 1.0.
- Not clear that all crews would send an AO up to the roof immediately upon reaching Step 7 in EOP 1.0.
- Agreed that if did not send someone during EOP 1.0, most crews would at least begin the process of preparing an AO for the task before reaching Step 14 of EOP 6.0.
- Staff noted that in a recent training simulation of the scenario, an AO was dispatched to the roof to close the ADV during EOP 1.0.
- Agreed that not all crews would initiate the action that quickly – likely to be fairly busy.
- Main influences (aleatory factors) that together would lead to a high failure probability to perform the action within 30 minutes are:
  - Bad weather and problems executing the action
  - Methodical or "non-aggressive" crew
  - Problems with ADV status indication

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Distributions for OP-ISOADV-1A-30M: Failure to isolate a stuck-open atmospheric dump valve (ADV) within 30 minutes of the initiating event.

Analysts	Percentiles						
	1st	10th	25th	50th	75th	90th	99th
#1	0.01	0.03	0.05	0.08	0.4	0.8	1.0
#2	0.001	0.003	0.008	0.02	0.07	0.1	0.8
#3	0.001	0.01	0.03	0.06	0.4	0.6	0.9
#4	0.005	0.01	0.02	0.033	0.1	0.6	0.8
Consensus	0.004	0.01	0.03	0.05	0.2	0.5	0.9

Two analysts were NRC contractors and two were plant staff

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Overview of ATHEANA User's Guide (for Prospective Analysis) and Recommended Revisions From Peer Review

Susan Cooper (USNRC)
Erasmia Lois (USNRC)
John Forester (SNL)
Alan Kolaczkowski (SAIC)

Presentation to the Advisory Committee on Reactor Safeguards, PRA and Human Factors Subcommittees

Rockville, MD June 28, 2006

Presented By
Susan Cooper

1

Overview

- Purpose of the ATHEANA User's Guide
- Overview of the current ATHEANA User's Guide
- Discussion of basic quantification formulation
- Discussion of suggested revisions from peer reviewers and NRC senior staff
  - Soliciting ACRS feedback on suggestions
- Next steps

2

Purpose of the User's Guide

- Provide better understanding of ATHEANA
  - What is the ATHEANA process
  - How and when to apply it
  - Strengths and limitations
- Provide updated guidance on the overall prospective HRA process in light of lessons learned from ATHEANA HRA/PRA applications
  - Retrospective analysis is not in the scope of User's guide
- Provide complete guidance on how to apply the ATHEANA HRA quantification approach
- Simplify the guidance – make it easier to understand and use
  - While still relying on NUREG-1624 as a major source of information (i.e., the User's Guide would be an addendum rather than a "stand alone" document)

3

Quantification Process
(continued)

- One UA is usually enough, but may have multiple EFCs
  - Nominal "EFC"
  - EFCs involving random physical deviations in plants conditions that could cause problems for the crew
  - Various other important aleatory influences such as nuisance alarms, time of day, important instrument failures, etc.

7

Comments/Suggested Changes to User's Guide
From Peer Review and from Senior NRC Staff

- Explicitly identifying and addressing a range of EFCs seen as a strong point of ATHEANA
  - Quantify the probability of each EFC and the probability of the UA for each EFC (i.e., keep each separate from the other)
- Provide more formal guidance for selecting EFCs to be included and for limiting the number of EFCs to as few as necessary
  - Goal is to capitalize on process for identifying important contexts (high-value added) while limiting resource demand
- Focus on point estimate for the HEP
  - The range of EFCs addresses aleatory uncertainty
  - Use expert judgment or other approach to estimate epistemic uncertainty if needed

8

Comments/Suggested Changes to User's Guide
(Continued)

- Provide more structure and formalism in the quantification process to support repeatability
- To support effective use of the information obtained from the ATHEANA qualitative analysis, provide more guidance on the use of the information during quantification
- Provide more prescriptive connection between conditions and HEPs
  - Tie only a single value or range of values to the different likelihood categories (likely to fail, infrequently fails, unlikely to fail, etc.)
- Possibly have more than 1 way to quantify
- Possibly include some "reference cases" to support quantification
- Given the broader range of PSFs addressed with ATHEANA, provide sharper definitions of each PSF to minimize overlap and support consideration

9

Comments/Suggested Changes to User's Guide (Continued)

- Make the User's Guide a "stand alone" document, rather than an addendum to NUREG-1624, Rev. 1
  - Include important information in NUREG with improved guidance in User's Guide
  - Include detailed guidance for retrospective analysis
- As an additional support to users, provide more complete set of detailed examples of the critical aspects and steps of the process (e.g., deviation scenarios) and carry throughout the document (include EOOs and EOCs)
- Provide more on the conditions under which an ATHEANA analysis will significantly "add value." For example,
  - Better identification and understanding of important events in full power operations
  - Special studies
  - Non-proceduralized actions
  - SAMGs
  - Fire scenarios

10

Comments/Suggested Changes to User's Guide (Continued)

- Clarify when a full-blown ATHEANA analysis needs to be performed and when other options might be acceptable
- Provide guidance on when applying only parts of the process would be appropriate/add value
  - Vulnerability search and deviation analysis would support trainers and improve practices
  - Retrospective analysis to understand events and support improvements
- The ATHEANA method has the potential to lead to a resilient engineered system. Do more to emphasize the added value.

11

Comments/Suggested Changes to User's Guide (Continued)

- Provide more detail/clarification on miscellaneous aspects of the process:
  - Identification of HFEs
  - Why and when to go UA level
  - Modeling of EOCs in PRA (new events in the event trees will usually need to be created)
  - Screening
  - Treatment of dependencies (treated as part of the EFC)
  - Recovery by self, crew (function of the context, not an "add on")
  - Relationship between steps 5, 6, and 7
- Add a reasonableness check of HEPs as part of process
- Clarification of terminology - extend glossary
- Have someone else do an actual test of the process before finalizing

12

Bottom Line

- Peer review comments were positive about the advantages of ATHEANA, but also provided a substantial number of suggestions for improving the User's Guide and making it more user friendly
- Reviewers continue to be positive about the qualitative insights that can be gained by using ATHEANA
  - But want to see better examples of the process
- Reviewers suggest improvements to the quantification process are needed
  - Keep it true to the equation
  - More formality/prescriptive
  - But simple (limited EFCs, simple/repeatable HEP estimation)
- Comments suggest that for ATHEANA to be a regularly used tool (especially in the prevailing "climate" that other HRA methods are sufficient for today's uses)
  - Its benefits need to be clearly documented and illustrated in the Guide
  - Ways to use just "portions" of ATHEANA process need to be addressed

13

Next Steps

- Revise User's Guide on basis of comments and ACRS feedback
- Create a revised version of the prospective analysis process for a pilot application
- Provide revised NUREG in Summer 2007
- Develop a separate User's Guide to support retrospective analysis

14

Public Comments on HRA Methods Evaluation NUREG-1842
(Draft for Public Comment)

Erasmia Lois (USNRC)
Alan Kolaczkowski (SAIC)
John Forester (SNL)
Susan Cooper (USNRC)

Presentation to the Advisory Committee on Reactor Safeguards, PRA and Human Factors Subcommittees

Rockville, MD June 28, 2006
Presented By
Erasmia Lois

1

Background/Status

- The NRC has developed the "PRA Action Plan for Stabilizing PRA Expectations and Requirements," (SECY-04-0118) to address PRA quality issues
- Guidance for performing/reviewing human reliability analyses (HRAs) is part of the plan
- Guidance is developed in two phases:
  - Phase 1: HRA Good Practices--NUREG-1792, completed
  - Phase 2: Evaluation of methods against the Good Practices, in progress
- Status of HRA methods evaluation
  - Draft report submitted for internal review, including ACRS
  - Addressed comments from ACRS sub- and full committees and others: February 2006
  - Released for public comment: April 2006
  - Public comments received
  - Revise/submit to publication: September 2006

2

Summary of Comments

- Concern about overall negative impression of the document about HRA and recommendations that the NUREG should be revised to provide a "more balanced message"
  - Highlight that current tools and methods are considered sufficiently robust for many applications and are being successfully used to make risk-informed decisions
- In some cases, reviewers agree with some of the stronger criticisms in the document
  - E.G., original HCR was not substantiated by simulator experiments and so its use is not recommended

5

Summary of Comments - continued

- Document implies HEPs are inaccurate (as a group) and instead, should acknowledge that all models are approximations with uncertainties (just like for hardware failures)
- Reviewers agree that "method" is a misleading title for many of the HRA tools reviewed – consider other wording
- Many comments about not giving full credit to many of the Calculator's capabilities and benefits
- The Calculator continues to be revised (in part, in recognition of concerns that are raised in the document) and is now Version 3 – EPRI recommends that NUREG-1842 should reflect the new version

6

Summary of Comments - continued

- Consider reviewing (or at least acknowledging) simulation modeling techniques of human performance that are being developed
- A few comments provided on the individual method reviews to correct/clarify inaccuracies or misleading statements
- Concern about "scope (i.e., requirements) creep"
  - Should compare against ASME/R.G. 1.200 and not the "Good Practices" – ASME/R.G. 1.200 are sufficient and provide the requirements to be met
  - Concern that Good Practices go beyond the above (e.g. EOCs)
- Recommendation to use actual experience instead of ASEP or THERP for pre-initiator quantification—industry has developed over the years appropriate data sources

9

Going Forward

- Expect to remain on schedule to meet September 2006 submittal for publication
- Plan to incorporate the points made in most of the comments (examples)
  - Provide clarifications where misinterpretations of the document have occurred
  - Correct any specific inaccurate statements
  - Acknowledge successful use of current methods
  - Incorporate Version 3 of the Calculator (if we receive information quickly)
- Some suggestions are beyond the intent of this document
  - Address HRA specialist/expert qualifications
  - Provide examples of uses of the methods and the corresponding levels of effort

10

Human Reliability Analysis Theory

Treatment of Timing

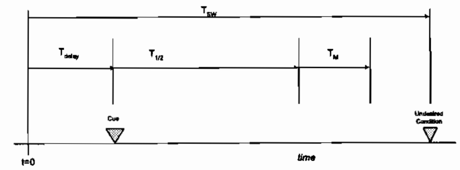
ACRS Sub-committee

27 June 2006

Jeffrey A. Julius, Scientech LLC
Frank Rahn, EPRI
Zouhair Elawar, HRA User Group Chairman

EPRI

Post-Initiators: Timeline



T_{SW} = System time window

T_{delay} = Time from start of transient until cue is reached

T_M = Manipulation time

$T_{1/2}$ = Median response time

$T_W = T_{SW} - T_{delay} - T_M$ = Time window for cognitive response

$T_w - T_{1/2}$ = Time available for recovery

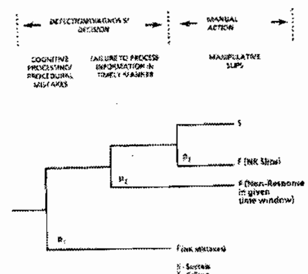
EPRI

Post-Initiators: Timing Data Sources

- **T_{SW} is obtained from thermal hydraulic analyses**
  - FSAR (RELAP, RETRAN ...)
  - MAAP runs
  - Vendor specific studies
- **T_M can be obtained**
  - Plant specific simulator data
  - Plant specific operator interviews
  - JPMs (for actions outside control room)
  - Estimation (1 min for CR front panel, 2 min for back panels, travel time for actions outside control room.)
- **Recommended methods to obtain sigma and $T_{1/2}$**
  - Plant specific simulator data
  - Plant specific operator interviews
  - Generic data or decision tree estimation

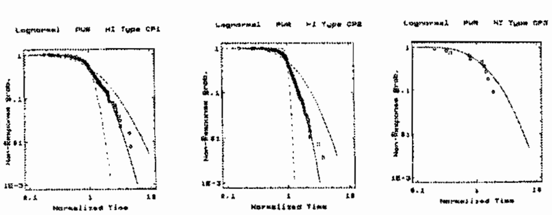
EPRI

REPRESENTATION OF TYPE C HFEs



EPRI

HCR/ORE Empirical Results



EPRI

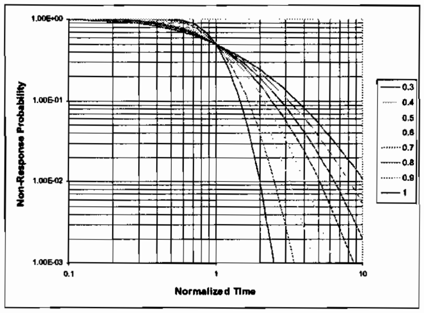
HCR/ORE Correlation

$$P_C = 1 - \Phi\left[\frac{\ln(\frac{T_W}{T_{1/2}})}{\sigma}\right]$$

- P_C = probability of cognitive non-response
- σ = logarithmic standard deviation
- Φ = standard normal cumulative distribution
- $T_W = T_{SW} - T_{delay} - T_M$ = time window for cognitive response
- $T_{1/2}$ = crew median response time

EPRI

Post-Initiators: HCR/ORE Characteristics



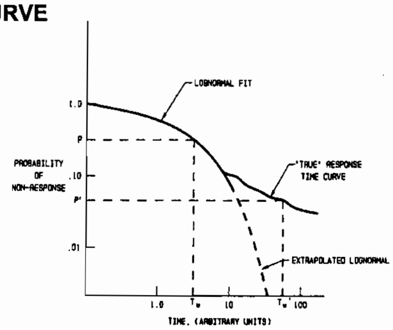
7 EPRI

HCR/ORE Correlation

- Empirical method
- Fitted to successful response times
- Data points in which crews were totally on the wrong path not included in the fitting ("outliers")
- P_c therefore conditional on a correct decision, or the initial error was discovered in a timely manner
- Normalized time to be limited to time windows on which observations were made. Extrapolation not valid
- Guidance in EPRI-TR100259:
  - If P_c < 1E-02, use the CBDTM
  - If P_c believed to be conservative, use CBDTM

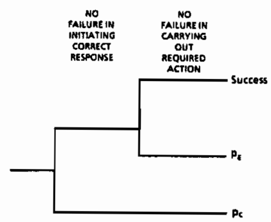
8 EPRI

HCR/ORE AND "TRUE" TIME RESPONSE CURVE



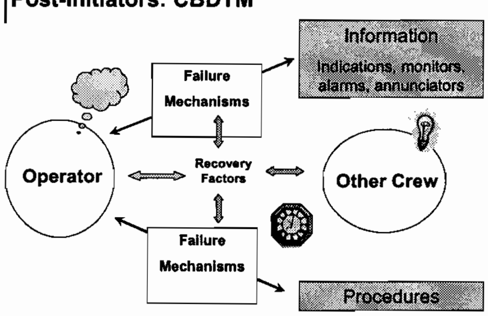
9 EPRI

REVISED REPRESENTATION OF TYPE C HFEs



10 EPRI

Post-Initiators: CBDTM



11 EPRI

EPRI CAUSE BASED DECISION TREE METHOD (CBDTM)

- **Framework for quantifying p_c**
- Analytical approach based on identification of failure mechanisms and compensating factors
- Applicable to **rule-based behavior** as when procedures are used
- **Two high-level failure modes:**
  - Plant information-operator interface failure
  - Operator-procedure interface failure
- Each **failure mode is decomposed** into contributions from several distinct failure mechanisms

12 EPRI

EPRI CBDTM QUANTIFICATION SUMMARY

$$p_c = \sum_{i=1,2} \sum_j p_{ij} p_{nr}^{ji}$$

Where p_{ij} is the probability of mechanism j of the mode i occurring initially for the HI, and the p^{ji}_{nr} is the probability of non-recovery from mechanism j in mode i.

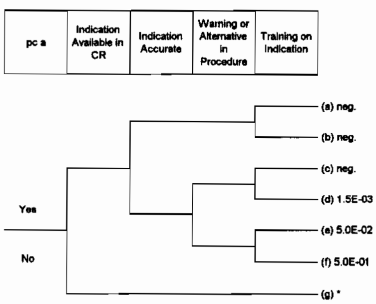
13 EPRI

Post-Initiators: CBDTM Failure Mechanisms

Type	Designator	Description
Failures in the Operator–Information Interface	p_c a	Data not available
	p_c b	Data not attended to
	p_c c	Data misread or miscommunicated
	p_c d	Information misleading
Failures in the Operator-Procedure Interface	p_c e	Relevant step in procedure missed
	p_c f	Misinterpret instruction
	p_c g	Error in interpreting logic
	p_c h	Deliberate violation

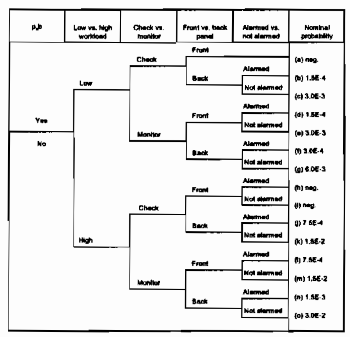
14 EPRI

CBDTM decision tree: pc-a Data not available



15 EPRI

CBDTM decision tree: pc-b Data not attended to



16 EPRI

Post-Initiators: CBDTM Recovery

Type	Decis. Tree	Description	Recovery
Failures in the Operator–Information Interface	p_c a	Data not available	Per matrix
	p_c b	Data not attended to	Per matrix
	p_c c	Data misread or miscommunicated	Per matrix
	p_c d	Information misleading	Per matrix
Failures in the Operator-Procedure Interface	p_c e	Relevant step in procedure missed	Per matrix
	p_c f	Misinterpret instruction	Per matrix
	p_c g	Error in interpreting logic	Per matrix
	p_c h	Deliberate violation	Per matrix

17 EPRI

Post-Initiators: CBDTM Recovery Factors

Tree	Branch	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review
Pca	all	NC	0.5	NC	0.5	0.5
Pcb	all	X	NC	X	X	X
Pcc	all	NC	NC	X	X	X
Pcd	all	NC	0.5	X	X	0.1
Pce	a-h	X	0.5	NC	X	X
Pce	i	0.5	0.5	X	X	X
Pcf	all	NC	0.5	X	X	X
Pcg	all	NC	0.5	X	X	X
Pch	all	NC	X	X	NC	NC

18 EPRI

Use of HRA Calculator™ Contact Information

- Public website:
  - www.epri.com/hra/index.html
  - Disseminate amongst interested non HRA UG members
- Support website for HRA Users Group:
  - www.epriweb.com/epriweb2.5/ecd/np/hra/index.html
  - Use for bug reporting, suggestions, downloads
- For software support & user group suggestions:
  - Jan Grobbelaar (jgrobbelaar@scientech.com) 800.862.6702
  - Jeff Julius (jjulius@scientech.com) on 800.862.6702
- For EPRI project management support contact:
  - Frank Rahn (frahn@epri.com) at 650 855.2037

19 EPRI

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20

Backup Slides

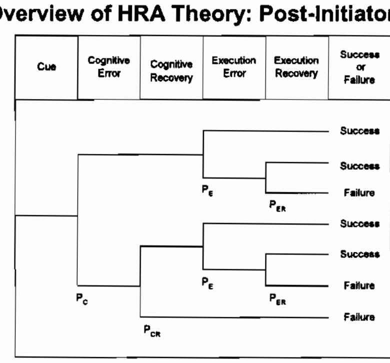
EPRI

Post Initiators: Definition

- Define a set of human failure events (HFEs) as unavailabilities of functions, systems or components as appropriate to the level of detail in the accident sequence and system models
- Include in the definition:
  - Accident sequence specific timing of cues, and time window for successful completion, and
  - Accident sequence specific procedural guidance (e. g., AOPs, and EOPs), and
  - The availability of cues and other indications for detection and evaluation errors, and
  - The specific detailed tasks (e.g., component level) required to achieve the goal of the response. (Cat III)
- Cognitive and Execution elements

22 EPRI

Overview of HRA Theory: Post-Initiators



23 EPRI

Post-Initiators: Quantification

- Cognitive and execution errors
- Timing
  - Cues
  - Time required
  - Time available
- Performance Shaping Factors

24 EPRI

Post-initiator methodologies implemented in the EPRI HRA Calculator

- Cause Based Decision Tree Method (CBDTM)
- HCR/ORE
- THERP execution analysis
- THERP annunciator response model
- SPAR-H

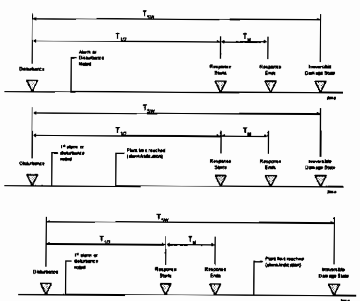
25 EPRI

FAQ: Which Method Should I Use?

Plant Condition	Cue/Type	Method	Example
Normal operation	Routine activities	THERP ASEP	Calibration of RWST bistables
Normal operation	Alarm or annunciator	Annunciator Response Model	Loss of a CCW pump
Post Reactor Trip	Immediate actions	HCR/ORE	Manual reactor trip
Post Reactor Trip	Time critical actions	HCR/ORE CBDTM	Establish seal injection within 13 minutes
Post Reactor Trip	Procedural Response	CBDTM	Isolate ruptured SG
Post Reactor Trip	Non proceduralized actions	Qualitative HCR/ORE	Recovery actions
Post Reactor Trip with Plant Stabilized	Alarm or annunciator	THERP Annunciator Response Model	CST low level
Historical. Pre-cursor Events	Findings	All + SPAR-H	SDP issues

26 EPRI

HCR/ORE: Cue response structures



27 EPRI

HCR/ORE: Sigma values based on cue-response structure

Plant Type	Cue-Response Structure	Values for σ		
		Average	Upper Bound	Lower Bound
BWRs	CP1	0.70	1.00	0.40
	CP2	0.58	0.96	0.20
	CP3	0.75	0.91	0.59
PWRs	CP1	0.57	0.88	0.26
	CP2	0.38	0.69	0.07
	CP3	0.77	*	*

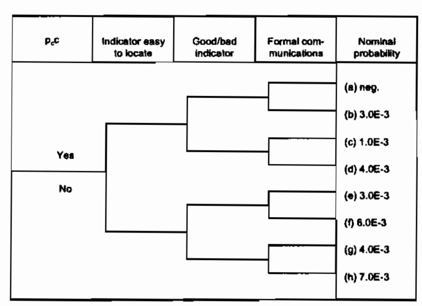
28 EPRI

Post-Initiators: CBDTM Recovery Factors

Recovery Factor	Time Effective
Other (Extra) Crew	At any time that there are crew members over and above the minimum complement present in the CR and not assigned to other tasks
STA	10 to 15 minutes after reactor trip.
ERF/TSC	1 hour after reactor trip – if constituted
Shift Change	6 hours after reactor trip given 8 hour shifts 9 hours after reactor trip given 12 hour shifts

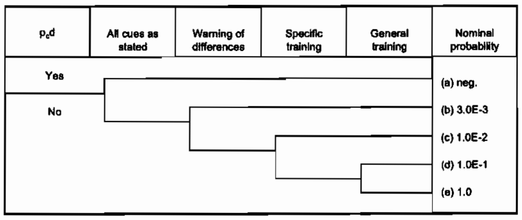
29 EPRI

CBDTM decision tree:
pc-c Data misread or miscommunicated



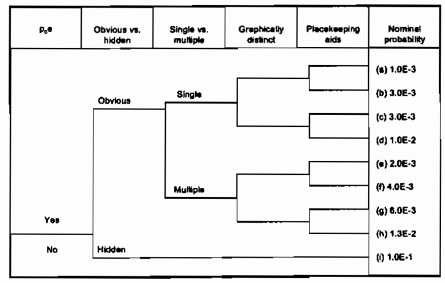
30 EPRI

CBDTM decision tree: pc-d Information misleading



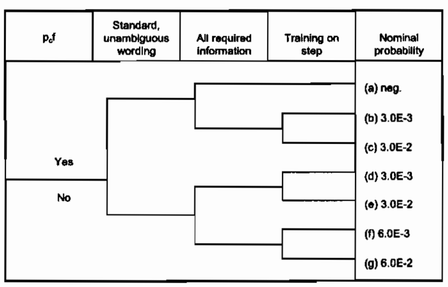
31

CBDTM decision tree: pc-e Relevant step in procedure missed



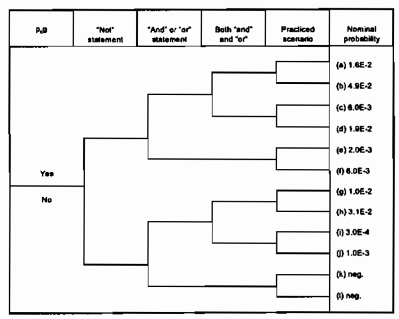
32

CBDTM decision tree: pc-f Misinterpret instruction



33

CBDTM decision tree: pc-g Error in interpreting logic



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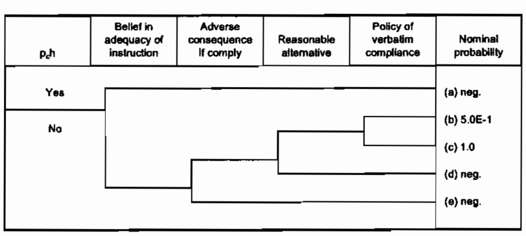
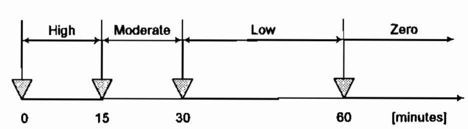
CBDTM decision tree: pc-h Deliberate violation



35

Post-Initiators: THERP - Impact of dependencies

- Recovery needs to be accomplished within time available for recovery
- The same rule is applied as with CBDTM: the time available for recovery imposes a minimum level of dependence:



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Post-Initiators: Dependency formulas

Level of Dependence	Conditional Probability Equation (N = HEP)	Approximate Value for Small N
Zero dependence (ZD)	N	N
Low Dependence (LD)	$\frac{1+19N}{20}$	0.05
Medium dependence (MD)	$\frac{1+6N}{7}$	0.14
High Dependence (HD)	$\frac{1+N}{2}$	0.5
Complete Dependence (CD)	1.0	1.0

EPRI

Time to Accomplish Actions as a Dependent Measure in Human Reliability Analysis (HRA)

Erasmia Lois (USNRC)
Susan Cooper (USNRC)
Nathan Siu (USNRC)
John Forester (SNL)
Alan Kolaczkowski (SAIC)

Presentation to the Advisory Committee on Reactor Safeguards, PRA and Human Factors Subcommittees

Rockville, MD June 28, 2006

Presented By
John Forester

1

Current Treatment of Time in HRA

- Time reliability correlation (TRC) approach focuses on probability of non-response as a function of time
  - HCR/ORE relies on simulator exercises to estimate the median time to respond
    - Probability of non-response a function of the time available
    - Factors driving time to respond not explicitly addressed
  - THERP/ASEP TRCs are conceptually similar, but with a few performance-shaping factors (PSFs) considered
- Other approaches (e.g., ATHEANA, SPAR-H) also consider the time available to respond in determining likelihood of success/failure
  - Treated as a factor influencing the likelihood of success/failure (but more like a success criteria than a PSF)
  - May also consider "time pressure" as a PSF and other factors that could increase the time needed to perform the required actions (e.g., workload)

2

Treating Time as Dependent Measure (Predicting the Time to Accomplish Actions)

- Extends concept of TRC, but focuses on consideration of factors (PSFs) that could influence the time to accomplish actions
  - Develop a distribution of the likely time to accomplish actions based on influencing factors and derive probability of non-response based on overlap with distribution for time available
- Potential benefits
  - Time to accomplish an action can more easily be observed and measured than can probability of failure
  - Allows incorporation of software simulation modeling tools to address HRA issues
    - Tools to simulate individual and group performance (e.g., as being developed and used for DOD applications)
    - Integration of human simulation with existing physical system simulations (e.g., RELAP, MELCOR)
  - May be particularly relevant to addressing actions outside the control room during unique situations (e.g., fires)

3

Treating Time as Dependent Measure (Predicting the Time to Accomplish Actions) (continued)

- Challenges
  - Modeling of actions and alternate scenarios
    - Handling of misdiagnosis whereby the human starts off on the "wrong path" for some reason
      - How to model failure in the context of predicting time to accomplish actions
      - Factors influencing errors may be different than those influencing delays in responding etc.
    - Handling of situations where operators "choose" to not perform an action until some later time because of the context
  - Treatment of dependencies within a sequence/scenario

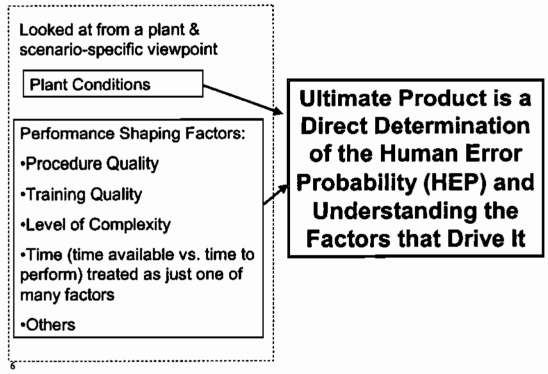
4

Treating Time as Dependent Measure (Predicting the Time to Accomplish Actions) (continued)

- Challenges (continued)
  - Different data needs to support analysis and "quantification"
  - For software simulation modeling, identifying appropriate level of detail, e.g.,
    - Task versus cognitive simulation
- Additional thinking/investigation/research needed prior to initiating model development

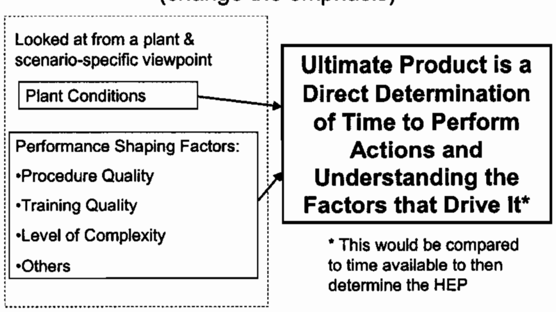
5

Simple Representation of Current HRA Approaches



6

Simple Representation of a Modified HRA Approach (change the emphasis)



* This would be compared to time available to then determine the HEP

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